May 16, 2013

MEMORANDUM TO: Michael T. Markley, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

FROM: Eric E. Bowman, Acting Chief ***/RA/***
Generic Communications Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR PALO VERDE OVERALL INTEGRATED PLAN IN RESPONSE TO MARCH 12, 2012 COMMISSION ORDER TO MODIFY LICENSES WITH REGARD TO REQUIREMENTS FOR MITIGATION STRATEGIES FOR BEYOND-DESIGN-BASIS EXTERNAL EVENTS (ORDER NUMBER EA-12-049)

By letter dated February 28, 2012 (Agencywide Documents Access and Management System Accession No. ML130700342), Arizona Public Service Company submitted Palo Verde Nuclear Generating Station's Overall Integrated Plan in Response to March 12, 2012 Commission Order to Modify Licenses with Regard to Requirements For Mitigation Strategies For Beyond-Design-Basis External Events (Order Number EA-12-049). The Generic Communications Branch, in conjunction with the technical staff of the Divisions of Engineering and Safety Systems is currently reviewing the submittal to ensure compliance with the Order and has determined that additional information is necessary to complete the review. Please issue the attached request for additional information as publically available to the licensee.

Enclosure:
Request for Additional Information

CONTACT: John Klos, NRR/DPR
301-415-5136

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ADAMS ACCESSION NO.: ML13105A018 * By e-mail **With comments

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Request for Additional Information Regarding Palo Verde Generating Station Overall Integrated Plan in Response to Order EA-12-049

049-RAI-Palo Verde-1

Please identify any License Amendment Requests that are necessary for modifications proposed in the integrated plan.

049-RAI-Palo Verde-2

Table 1A lists the operator actions and associated completion times to mitigate the consequences of an extended loss of ac power (ELAP).

Discuss how the plant-specific guidance and strategies and the associated administrative controls and training program will be developed and implemented to assure that the required operator actions are consistent with that assumed in the CENTS analysis and can be reasonably achievable within the required completion times.

049-RAI-Palo Verde-3 Pages 18 and 19 state:

> Table Item 9 – Open Control Room Doors: Block open doors to provide ventilation to maintain control room temperature. Reference 12, Section IX.3 provides a list of rooms reviewed (including the control room) and predicted temperatures. Because load shed is to be completed within 2 hours, heat loads in the control room are minimal (only essential identified instrumentation is powered). It is predicted that long term control room temperature would approach outside air temperature, per design. The PVNGS FSG (Reference 13) will also include steps to open control room doors.

Section 9.2 of NEI 12-06 states, "Virtually every state in the lower 48 contiguous United States has experienced temperatures in excess of 110°F. Many states have experienced temperatures in excess of 120°F."

Pages 51 and 52 of the submittal state that ventilation is not required in Phase 1 and it will not be recovered until Phase 2 (approximately 28 hours after the ELAP).

a. Has a plant-specific, thermal hydraulic calculation been performed to determine what the maximum control room temperature would be based on the NEI 12-06 conditions? If so, please provide a summary of the calculation and its results concluding that control room habitability limits will be maintained in all Phases of the ELAP event. If not, please provide the basis and justification for concluding that main control room ventilation will not be required to maintain habitability limits until Phase 2 (28 hour mark) of the ELAP event.
b. NEI 12-06 relies on the guidance from NUMARC 87-00 for a 110° F limit for efficient human performance. NUMARC 87-00 provides the technical basis for this

habitability standard as MIL-STD-1472C, which concludes that 110°F is tolerable for light work for a 4 hour period while dressed in conventional clothing with a relative humidity of ~30%. In light of this technical basis, please provide justification for the long term habitability of the main control room and/or please indicate what additional relief efforts for the main control room staff will be provided (e.g. short stay time cycles, use of ice vests/packs, supplies of bottled water, etc.).

c. Please clarify the number of plant personnel assumed to be present in the control room for this analysis relative to the number of personnel that may be present during an ELAP event.
d. Please discuss the postulated outside air temperature.

049-RAI-Palo Verde-4

Page 24 of the response states that one train of ADV solenoids will be de-energized during load shed. Please explain the necessity or prudence of this action and clarify the time required to restore power to the de-energized train if it becomes necessary.

049-RAI-Palo Verde-5

Page 15 states that instrumentation on FLEX equipment will be used to confirm adequate performance of equipment functions. Describe the instrumentation that will be used to monitor portable/FLEX electrical power equipment including their associated measurement tolerances/accuracy to ensure that: 1) the electrical equipment remains protected (from an electrical power standpoint – e.g., power fluctuations) and 2) the operator is provided with accurate information to maintain core cooling, containment, and spent fuel cooling.

049-RAI-Palo Verde-6 Page 18 states the following:

> Table Item 7 - Complete DC Load Shed: DC load shed must be completed within 2 hours in order to achieve a battery coping time of 47 hours on battery bank B (Reference 16, Section 8.6). For Phase 1, PVNGS can cope on the installed DC batteries for up to 10 hours with no load shedding. If load shedding, as described in PVNGS Study 13-NS-A108 (Reference 12), is completed, the battery coping period is extended to 47 hours. This load shed strategy will preserve station batteries and provide additional time prior to needing to re-energize battery chargers.

a. Provide the dc load profile for the mitigating strategies to maintain core cooling.

b. Provide a detailed discussion on the loads that will be shed from the dc bus, the equipment location (or location where the required action needs to be taken), and the required operator actions needed to be performed and the time to complete each action. In your response, explain which functions are lost as a result of shedding each load and discuss any impact on defense in depth and redundancy.

i. Are there any plant components that will change state if vital ac or dc is lost, de-energized, during this evolution of dc load shed? When the operators manipulate dc breakers to load shed, will plant components actuate, de-energize pumps, etc.? The staff is particularly interested that a safety hazard is not created, such as de-energizing the dc powered seal oil pump for the main generator, which would allow the hydrogen to escape to the atmosphere, which may cause an explosion or fire, and may be compounded by high heat from the main turbine bearings if not cooled.

ii. Which breakers will operators open as part of the load shed evolutions?

iii. Will the dc breakers to be opened be physically identified by special markings to assist operators manipulating the correct breakers?

c. The integrated plan states that the batteries can last up to 10 hours with no load shedding and up to 47 hours with load shedding. The Institute of Electrical and Electronics Engineers (IEEE) Standard 535-1986, "IEEE Standard for Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Stations," as endorsed by Regulatory Guide 1.158, "Qualification of Safety-Related Lead Storage Batteries for Nuclear Power Plants," provides guidance for qualifying nuclear-grade batteries and describes a method acceptable to the NRC staff for complying with Commission regulations with regard to qualification of safety-related lead storage batteries for nuclear power plants. Provide documentation that shows that your battery cells fully comply with the qualification principles in clause 5 and meet the requirements in clause 8.2 of IEEE Standard 535, for the duration you are crediting the station batteries in your mitigating strategies integrated plan (See Agencywide Documents Access and Management System Accession No. ML13094A397 for additional information).

049-RAI-Palo Verde-7

Page 51 states that dc bus voltage is required to be monitored in order to ensure that the dc bus voltage remains above the minimum voltage. Provide the minimum voltage that must be maintained and the basis for the minimum voltage on the dc bus.

049-RAI-Palo Verde-8

Regulatory Position C.6 in Regulatory Guide 1.128, "Installation Design and Installation of Vented Lead-Acid Storage Batteries for Nuclear Power Plants," states that conformance with the IEEE Std. 484-2002 requirements (indicated by the verb "shall") for installation design and installation of vented lead-acid storage batteries for nuclear power plants provides an adequate basis for complying with the design, fabrication, erection, and testing requirements set forth in GDCs 1, 17, and 18 of Appendix A to 10 CFR Part 50, as well as Criterion III of Appendix B to 10 CFR Part 50, subject to the following stipulation: In Subsection 5.4, "Ventilation," revise the second sentence to be consistent with Regulatory

Guide 1.189, as follows: "The ventilation system shall limit hydrogen accumulation to one percent of the total volume of the battery area."

Provide a discussion on how hydrogen concentration in the battery rooms will be maintained below the limits established by national standards and codes (i.e., less than 1% according to the National Fire Code and Regulatory Guide 1.128, "Installation Design and Installation of Vented Lead-Acid Storage Batteries for Nuclear Power Plants," which endorses IEEE Standard 484, with exceptions) when the batteries are being recharged during Phase 2 and 3.

049-RAI-Palo Verde-9

Page 21 states that PVNGS will use the standard EPRI industry preventative maintenance template for establishing the maintenance and testing actions for FLEX components and that the administrative program will include maintenance guidance, testing procedures and frequencies established based on type of equipment and considerations made within the EPRI templates. Provide details of the maintenance and testing plan for electrical equipment that is credited for events that require mitigating strategies. The staff is trying to understand how Regulatory Guidance documents, IEEE Standards, manufacturer recommendations, etc. will be utilized to establish the maintenance and testing programs for the portable/FLEX electrical equipment, especially for batteries and diesel generators.

049-RAI-Palo Verde-10

Page 59 states that the medium voltage (MV) FLEX generator will be connected to the Class 1E 4.16kV switchgear via an installed FLEX junction box mounted outside on either the west or east wall of the diesel building as shown in Figure 3-39 and Figure 3-41. Describe how the MV FLEX generator and the Class 1E diesel generators are isolated to prevent simultaneously supplying power to the same Class 1E bus in order to conform to NEI 12-06, Section 3.2.2, guideline (13), which specifies that appropriate electrical isolations and interactions should be addressed in procedures and guidance.

049-RAI-Palo Verde-11

General difference from WCAP-17601-P and PV analysis given in attachment 1B states that the time to begin cooldown is reduced from 2 hours to 1 hour. Based upon the licensee's response, the operators are performing numerous tasks during this first hour. SBO procedures require the operator to start the SBOG within one hour, plus the licensee credits performing a load shed on the dc bus within 2 hours, and opening doors within 2 hours. In addition, the licensee identified two actions with time constraints have been identified, observing the condition of the condensate storage tank (CST) and selecting valves that must be closed. In such a critical time operators will be stationed at critical components such as the steam driven AFW pump. The licensee states that they will perform simulator validations to confirm recognizing ELAP entry conditions. Provide a description of tasks to be performed and the personnel available to perform these tasks to allow the staff to evaluate the basis for concluding that these tasks can be reasonably accomplished in the time allotted.

049-RAI-Palo Verde-12

Means to move equipment. In its integrated plan, APS has identified that there is a time constraint of 34 hours to install portable 500 kW 480 V generators in order to recharge batteries. APS has not identified a means to move the generators along with the concomitant method for reasonable protection of that means from the identified hazards applicable to PVNGS as would be required to conform to the guidance of NEI 12-06, Section 5.3.2, consideration 5 and Section 9.3.2. APS has listed transportation equipment as equipment to be delivered in the final phase, but has identified an open item for the actual sequence and timing of delivery of the equipment. Please discuss the basis for concluding that the time constraint of 34 hours can reasonably be met for the installation of the portable generators as specified in NEI 12-06, Section 3.2.1.7, Principle 6, taking into consideration the specifications of NEI 12-06, Section 5.3.2, Consideration 5 and Section 9.3.2.

049-RAI-Palo Verde-13

Seismic procedural interface considerations 2 through 4. In its integrated plan, APS has provided insufficient information to support a conclusion that considerations 2 through 4 of NEI 12-06, Section 5.3.3, will be taken into account in the development of the mitigating strategies pursuant to Order EA-12-049. These considerations address the potential impacts of large internal flooding sources that are not seismically robust and do not require ac power, the potential reliance on ac power to mitigate ground water, and the potential impacts of non-seismically robust downstream dams. Please discuss the applicability of these considerations at PVNGS.

049-RAI-Palo Verde-14

Effects of high temperatures on portable equipment. In its integrated plan, APS has presented no information on the potential effects of high ambient temperatures at the locations where portable equipment would operate in the event it is necessary to use the strategies in order to allow the staff to evaluate conformance with NEI 12-06, Section 9.3.3. Please discuss the potential effects of high ambient temperatures on portable equipment in the locations such equipment would operate.

049-RAI-Palo Verde-15

Portable lighting. In its integrated plan, APS has presented no information on the identification in plant procedures and guidance of portable lighting such as flashlights or headlamps necessary for ingress and egress to plant areas required for deployment of the strategies in order to allow the staff to evaluate conformance with NEI 12-06, Section 3.2.2, paragraph (8). Please discuss arrangements for the use of portable lighting.

049-RAI-Palo Verde-16

In its integrated plan, APS has presented no information on access to the Protected Area and internal locked areas in order to allow the staff to evaluate conformance with NEI 12-06, Section 3.2.2, paragraph (9), Please discuss the effects of ac power loss on area access and the need to gain entry to areas where remote equipment operation is necessary.

049-RAI-Palo Verde-17 Use of CENTS for the Analysis of the ELAP Event

Page 17, Item 2 states, in part, that “CENTS is approved by the NRC for modeling natural circulation heat removal for single phase flow with vapor is present in the reactor vessel head and pressurizer.” Item 16 on page 72 indicates that within 49 hours of the event initiation, the RCS makeup pump should be installed for use to maintain sub-cooling natural circulation (NC) and to prevent two-phase NC.

Discuss the ELAP coping analysis using CENTS and show that two-phase NC will not begin prior to initiating the required RCS makeup pump within 49 hours. Discuss the specific CENTS-predicted RCS conditions that are used to define the initiation of two-phase NC and address adequacy of the use of the specific RCS conditions for determination of the time when two-phase NC begins.

049-RAI-Palo Verde-18 ADV Backup Nitrogen Supply and Manual operation of ADVs

Item 13 on page 19 indicates that the ADV backup nitrogen supply is sized for 16 hours, and Item 13 on page 71 requires that the operator manually operate the ADVs once the nitrogen supply is depleted in 16 hours.

Discuss the analysis determining the size of the subject nitrogen supply to show that the nitrogen source is available and adequate, lasting for 16 hours for use as motive force to operator the ADV.

Discuss the electrical power supply that is required for operators to throttle steam flow through the ADVs within 16 hours and show that the power is available and adequate for the intended use before the operator takes actions to manually operate the ADVs. Also, discuss the operator actions that are required to operate ADVs manually and show that the required actions can be completed within the required times.

049-RAI-Palo Verde-19

Please clarify the accuracy with which steam generator pressure can be controlled by manual operation of ADVs after the nitrogen supply is depleted. For example, should steam generator pressure drop too low, turbine-driven auxiliary feedwater flow could be interrupted or accumulators could rapidly empty. Please provide adequate basis to confirm that manual operation of the ADVs under ELAP conditions would be conducive to maintaining a reasonably constant steam generator pressure. Please further describe how manual ADV control will be accomplished (e.g., communication between the control room and a local operator stationed at the ADV), and, as applicable, whether environmental factors such as the potential for ambient noise and heat due to exiting steam have been considered.

049-RAI-Palo Verde-20 AFW Sources

Item 18 indicates that when the CST depletes, the TDAW pump suction path is required to realign to RMWT within 45 hours. Item 21 requires the operator to supply water from the water reclamation facility (WRF) to the CST within 116 hours when the available water in the CST and RMWT is depleted.

a. Discuss the analysis to show that the required CST - RMWT switchover time is no greater than 45 hours, and realignment time of the WRF to the CST is within 116 hours.
b. The licensee states that when the CST Empties- Switchover to Reactor Makeup Water Tank (RMWT) (Refueling Water Tank (RWT) (for high Seismic Event)): When the CST depletes, the TDAFW pump suction path is realigned to RMWT. Explain how core cooling will be maintained during this transition period.
c. Figure 3-3 on page 81 shows valve “V058” from the RMWT to the AFW suction piping. Describe the location of this valve and the probable accessibility following an ELAP event, and describe how the RWT can provide water to the AFW pump.
d. The description of Table Item 18 on page 19 indicates that for high seismic events the operators will switch over to the RWT, but this is not reflected in Table Item 18 on page 72 or Figure 3-3 on page 81. Describe how the RWT can provide AFW to the TDAFW pump.

049-RAI-Palo Verde-21

Page 23 indicates that the EOPs direct the operators to take action to confirm the closure of the main steam isolation valves (MSIVs). Simultaneous closure of MSIVs for all three units will result in loss of auxiliary steam to the air ejectors and loss of gland seal steam. Provide a description of the affects of losing auxiliary steam to all three units, especially on the turbine if vacuum is lost rapidly.

049-RAI-Palo Verde-22

Page 24 states, “Without ventilation, the TDAFWP room temperature will exceed 130°F within four (4) hours. PVNGS has determined that opening the access doors to the room within 2 hours will limit the temperature to a maximum of 130°F, thereby maintaining pump availability.”

a. This description implies that there is no margin to the maximum temperature. Please discuss conservatisms in the analysis and/or the identification of additional operational margin with respect to the TDAFWP room temperature and the continued operation of the TDAFWP.
b. Clarify whether the initial temperature condition assumed the worst-case outside temperature with the plant operating at full power. Provide the list of electrical components that are located in the TDAFWP room and are necessary to ensure successful operation of the TDAFWP. Also provide the qualification level for temperature and pressure for these electrical components for the duration that the TDAFWP is assumed to perform its mitigating strategies function.

049-RAI-Palo Verde-23 Instrumentation and Systems

a. List the safety and non-safety related systems or equipment that are credited in the ELAP analysis. For the non-safety related systems or equipment, discuss the safety functions that are intended to maintain and justify the non-safety related systems or equipment are available and reliable for their intended use.

b. Justify that the instrumentation listed on pages 25 - 26 and pages 33 - 34, and the associated setpoints credited in the ELAP analysis for automatic actuations and indications required for the operator to take appropriate actions are reliable and accurate in the containment harsh conditions with high moisture levels, temperature and pressure during the ELAP event.

049-RAI-Palo Verde-24 Reactor Coolant Pump (RCP) Seal Leakage

The last paragraph on page 32 and item 2 on page 74 indicate that PVNGS RCP seals are assumed to have a maximum leakage of 17 gpm per pump at normal operating pressure.

Discuss an analysis or RCP seal leakage testing data to show adequacy of the RCP seal leakage rate of 17 gpm per pump assumed in the ELAP analysis. The RCP seal leakage testing data used to support the assumed leakage rate should be applicable to the PVNGS RCP seals (with respect to the seal material, design and seal cooling systems) and ELAP conditions (in terms of the temperature and pressure, and seal failure mechanisms discussed in Section 6.4 of WCAP-17601) for an extended period consistent with the ELAP coping time. Also, address applicability of the information In Section 4.4.2 of WCAP-17601, Rev. 0, which states that “It has been shown that the probability of seal failure greatly increases when there is less than 50°F of subcooling in the Cold Legs.”

049-RAI-Palo Verde-25 RCP Seal Model

Item 36 on page 15 states that "… Operator actions are credited for cooling and depressurizing the RCS…. RCP seal leakage rates are dependent on RCS pressure and will decrease with deceasing pressure."

Discuss how CENTS calculates the pressure-dependent RCP seal leakage rates. If CENTS uses the equivalent size of the break area based on the initial leakage rate of 17 gpm per pump to calculate the pressure-dependent RCP seal leakage rates during the ELAP, discuss whether the size of the break area is changed or not in the analysis for the ELAP event. If the size is changed, discussed the changed sizes of the break area and address the adequacy of the sizes. If the break size remains unchanged, address the adequacy of the unchanged break size throughout the ELAP event in conditions with various pressure, temperature (considering that the seal material may fail due to an increased stress induced by cooldown) and flow conditions that may involve two-phase flow which is different from the single phase flow modeled for the RCP seal tests that are used to determine the initial seal leakage rate of 17 gpm).

049-RAI-Palo Verde-26 Core Sub-Criticality

The third paragraph on page 35 states that "…PVNGS control rod shutdown margin and borated water inventory in the RCS and SITs are sufficient to prevent re-criticality of the core."

Discuss the boron mixing model used for the re-criticality analysis in support of the plant FLEX mitigation strategies, and address the adequacy of the boron mixing model for the intended purpose with support of an analysis and/or boron mixing test data applicable to the ELAP conditions.

049-RAI-Palo Verde-27 Tables A and B - Portable Equipment for Phase 2 and 3

Tables A and B list the phases 2 and 3 portable equipment required for the ELAP mitigation. Table A lists four self priming pumps and four high pressure RCS makeup pumps that are required during the phase 2 of ELAP. The required capacities of the pumps are 370 gpm (at 500 psi) and 30 gpm (at 1525 psi) for the priming pumps and high RCS makeup pumps, respectively. Table B lists high pressure RCS makeup pumps and pumps to makeup to the CST from reservoirs that are required during the phase 3 of ELAP. The required capacities of the respective pumps are 30 gpm (at 1525 psi) and 1200 gpm (at 130 psi).

Specify the required times for the operator to realign each of the above discussed pumps and confirm that the required times are consistent with the results of the ELAP analysis.

Discuss how the operator actions are modeled in the ELAP to determine the required flow rates of the portable pumps, and justify that the capacities of each of the above discussed pumps are adequate to maintain core cooling during phases 2 and 3 of ELAP.

049-RAI-Palo Verde-28 Cooldown Analysis

Attachment 1A lists the sequence of events timeline for Mode 1-4. On page 70, item 11 indicates that the analysis assumes cooldown initiation time of 1 hour and that the RCS cooldown to 350° F is expected to complete within 4.11 hours of initiation of the event.

List the operator actions credited in the analysis to complete the cooldown from 1 hour to in 4.11 hours, and discuss how the operator actions are modeled in the cooldown analysis for the 4.11-hour period using CENTS.

049-RAI-Palo Verde-29 Time When TDAFWP Begins

Item 2 on page 68 indicates that at 0.017 hours (60 seconds), the TDAFWP begins.

The above information appears inconsistent with that listed in Table 5.1-1 of DAR-TDA12-2, (Reference 5 to the integrated plan), “Sequence of Events” for the case with the RCP leakage rate of 17 gpm/pump. Table 5.1-1 indicates that at 0.203 hours, the auxiliary feedwater (AFW) actuation signal actuates for steam generator (SG) 1. With a 60-second delay, the AFW flow to both SGs begins from the TDAFW pump at 0.22 hours. Clarify and correct the inconsistency.

049-RAI-Palo Verde-30 Section 3.2 of WCAP-17601-P Recommendations

Section 3.2 of WCAP-17601-P discusses the PWR Owners Group’s recommendations that cover following subjects for consideration in developing FLEX mitigation strategies: (1) RCP seal leakage rates; (2) adequate shutdown margin; (3) time initiating cooldown and depressurization; (4) prevention of the RCS overfill; (5) blind feeding an SG with a portable pump; (6) SIT performance; and (7) asymmetric natural circulation cooldown (NCC).

Discuss the licensee’s position on each of the recommendations discussed above for developing the FLEX mitigation strategies. List the recommendations that are applicable to the plant, provide rationale for the applicability, address how the applicable recommendations are considered in the ELAP coping analysis using CENTS, and discuss the plan to implement the recommendations. Also, provide rationale for each of the recommendations that are determined to be not applicable to the plant.

049-RAI-Palo Verde-31 Plant Specific Decay Heat Curve

Item 1 on page 74 indicates that the licensee uses a plant specific best estimate (BE) decay heat curve in the thermal hydraulic analysis for the ELAP event. The licensee states that the use of the plant-specific BE decay heat curve is a deviation from WCAP-17601, but claims that the deviation is justified by CN-REA-12-36 (Reference 7 to the integrated plan).

Provide the justification for the NRC staff to review. Alternatively, if CN-REA-12-36 has documented the appropriate justification, the licensee could provide the relevant pages for the NRC staff to review and approve.

049-RAI-Palo Verde-32

Describe the electrical power requirements for Phase 3 of the mitigating strategies integrated plan and provide the capacity of the power sources.

049-RAI-Palo Verde-33 Core Cooling with SG Not Available

The last paragraph indicates that "core cooling is maintained through once through heat removal from the RCS via coolant boil-off….During this event, a hot leg vent will have been established such that a release path is available to support once through via boil-off."

Discuss the analysis (including methods, assumptions, and results) to show that core cooling with SG not available can be maintained through once through heat removal from the RCS via coolant boil-off. Include in the discussion:

a. Discussion of how gravity feed flow from the RWT will be monitored and throttled to match core boiloff under ELAP conditions.
b. Discussion of the timing for providing primary makeup flow via gravity feed from the RWT relative to the time of core uncovery under reduced reactor coolant system inventory conditions.
c. Discussion of what supporting equipment is implied to be operable when a steam generator is considered available to mitigate an ELAP (e.g., turbine-driven auxiliary feedwater pump, main steam relief valves, atmospheric dump valves (ADVs)).
d. Discussion of scenarios wherein there is neither a hot leg vent nor a steam generator available, relative to the guidance of NEI 12-06. The staff understands that Generic Letter 88-17 recommended establishing a hot leg vent under conditions of reduced reactor coolant system inventory (i.e., water level lower than three feet below the reactor vessel flange), rather than on the basis of steam generator availability under ELAP conditions in shutdown and refueling modes. Furthermore, based on the requirement for high-pressure makeup

specified for shutdown modes without steam generators in Table 3-2 of NEI 12-06, it is not clear that scenarios without a hot leg vent are considered beyond scope.

049-RAI-Palo Verde-34

On pages 27 and 30 of the response, regarding the discussion of core cooling with steam generators not available in Phases 2 and 3, please provide the following items:

a. The basis for concluding that setting makeup flow to the steaming rate plus ten percent is sufficient to prevent significant boric acid precipitation in the core.
b. The source of borated coolant once the inventory of the refueling water tank is depleted (e.g., reactor grade water, raw water mixed with boric acid).

049-RAI-Palo Verde-35

Please provide justification that version 4.07 of the MAAP code has adequate capability for performing analysis to demonstrate the integrity of large-dry containments during ELAP conditions. The justification may include discussion of the adequacy of the code's relevant models and correlations, benchmarking of code calculations against relevant experimental data, and relevant comparisons to calculations with state-of-the-art containment analysis codes. The justification may further include the presence of significant margin to acceptance criteria, if applicable, for scenarios at power as well as during shutdown and refueling.

049-RAI-Palo Verde-36

Please clarify whether the mass and energy leakage to containment determined in the containment integrity analysis using the MAAP code are consistent with the predictions of the CENTS code. To the extent that data is available from existing simulations, please include plots comparing integrated mass and energy effluents from the two codes with and without the availability of the steam generators and provide justification if significant differences exist.

049-RAI-Palo Verde-37

Please discuss how the MAAP containment analysis models heat losses from the primary system to containment and provide justification for its adequacy.

049-RAI-Palo Verde-38

Please discuss the quality assurance process under which the MAAP calculations were performed.

049-RAI-Palo Verde-39

Page 16 states, "The actions specified for Mode 1 to Mode 4 conditions are bounding when compared to the Mode 5, Mode 6, and full core offload scenarios because the upper mode scenarios require the most personnel, actions, and time constraints."

Please provide the basis for this conclusion (e.g. analyses, studies, benchmarking, etc.) with particular emphasis on maintaining containment conditions as identified by Open Item #4.

049-RAI-Palo Verde-40

Please clarify whether the Open Item Table on page 67 should include pages 40, 41, (potentially) 42, and 43 under Affected Pages by OI4 rather than pages 45, 46, and 48. For Open Item #4, please describe the evaluation and/or analysis to be performed, the expected completion date, and the date the results will be made available to the NRC.

049-RAI-Palo Verde-41

Please clarify how the planned strategies for providing makeup to the spent fuel pool will be implemented while the pool is being cooled by boiling. For example, as noted on page 19 of the response, the fuel building rollup door is opened at 11.5 hours. On page 45, the response further notes that, with a full core offload, the most conservative time to boil is 3.3 hours. Finally, pages 45-47 refer to alternate mitigation equipment staging areas and connection points located inside the rollup door to the fuel building and the need to maintain accessibility to this area. Therefore, please identify the predicted peak temperature and humidity in the areas where accessibility is required during spent fuel pool boiling both prior and subsequent to the fuel building rollup door being opened, and confirm that conditions would be tolerable for operators over the expected exposure time for normal and core offload spent fuel heat loads. Provide validation that for escalated SFP boil off or leakage scenarios, implementation strategies include analysis of personnel resource availability to complete actions within implementation strategy time limits. Analysis needs to include personnel resource availability in consideration for other concurrent activities that also need to be performed site wide.

049-RAI-Palo Verde-42

Page 45 states that diesel driven pumps will be used to deliver the required flow rate through monitor type nozzles to provide water to the spent fuel pool. Provide a discussion on the diesel fuel oil supply (e.g., fuel oil storage tank volume, supply pathway, etc.) for the diesel driven pumps and how continued operation to ensure core and spent fuel pool cooling is maintained indefinitely (i.e., Phase 2 and 3).

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Please provide further information, and identify the methods to be used which will provide the minimum flow rates necessary for the SFP sprays, and account for the rates required for boil off due to the design basis heat load, and postulated losses due to leakage.

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Please provide further information that will clarify whether PVNGS uses heat tracing for freeze protection to conform to NEI 12-06, Section 3.2.2, guideline (12) as endorsed by JLD-ISG-2012-01.